Advanced manufacturing of porous ceramic structures for use in energy applications (invited)

Kaiser, Andreas; Bjørnetun Haugen, Astri; Zhang, Wenjing (Angela); Ovtar, Simona; Kiebach, Wolff-Ragnar; Hendriksen, Peter Vang

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Advanced manufacturing of porous ceramic structures for use in energy applications

A. Kaiser[*], *A.B. Haugen, W. Zhang, S. Ovtar, R. Kiebach, P.V. Hendriksen*

DTU Energy, Department of Energy Conversion & Technical University of Denmark (DTU), Frederiksborgvej 399, 4000 Roskilde, Denmark; [*]e-mail: akai@dtu.dk

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Tailored porous ceramic materials and structures are utilized in energy devices at DTU Energy, including electrochemical converters, membranes, adsorbents for gas separation and storage and catalyst supports. These materials can contain pore sizes from the nanometers to several millimeter, and can have oriented to random porosity or hierarchical porosity based on various pore architectures. Ceramic structures with tailored porosity can be processed by a variety of traditional or advanced shaping methods (phase inversion tape casting, templating, freeze casting, electrospinning, etc.).

Often, some additional challenges need to be addressed if porous support or catalysts layers with tailored porosity need to be integrated into asymmetric multilayer gas separation devices to achieve high performance.

For the fabrication of oxygen transport membranes (OTM)[1] or solid oxide fuel cells (SOFC), the shaping, multi-layering and co-firing of porous support structures in ceramic multilayer devices will be presented, which include the use of sacrificial templates (pore former) in extrusion[2,3] or phase inversion tape casting[4]. The correlation between the fabrication, the microstructure of the porous support structures and key performance parameters, such as gas transport, mechanical properties, thermal stability or electrical conductivity in the final ceramic multilayer structures and devices will be shown. Finally, a brief outlook on recently started R&D activities with highly porous ceramic structures will be presented, including novel concepts for the structuring of adsorbents in gas separation and storage.

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